VIDEO CONTENTS ACCESS METHOD THAT USES TRAJECTORIES OF OBJECTS AND APPARATUS THEREFOR

BACKGROUND OF THE INVENTION

Technical Field

The present invention relates to a method and an apparatus for using the trajectory of an object to access video contents, for example, to specify and display a specific video image scene.

PRIOR ART

To access the contents of a video, which constitutes a sequential media, a time must be designated for the portion that is to be accessed. Relative to this, the advantage of digital video is that immediate access to a desired scene is possible so long as a time is designated. However, to access a desired portion, the use of a specific guide is required. Presently, according to a typical technique used for this purpose, a story board is used whereon shot change images are arranged, and a desired shot change image can be accessed by clicking on the image. But there are video contents for which shot changes are meaningless, and only an image acquired at a specific time in a scene between shots can be used as a representative image. For example, in spots, shot changes are repeated for unimportant scenes to prevent a user from becoming bored, while for an important scene, images acquired using a camera with which it is anticipated the best images can be obtained

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are continued so as not to miss a moment of the important
scene. Therefore, since an important scene may be missed
by using a representative image obtained as a shot
change, an interface is required with which a scene can
5   be designated an important scene.

According to an example method for accessing the above
video contents, the trajectory of an object is extracted
from the video, and is used for a video search. With
10 this method, however, the trajectory of the object is
displayed and is superimposed on a video image on a
display device, so that the display image is difficult to
see and the video contents can not be efficiently
accessed. Further, according to this example, the video
15 search is performed only by matching trajectories. In
addition, even if the video contents can be accessed the
access efficiency is not satisfactory.

To resolve the above objectives, it is one object of the
20 present invention to provide a video contents access
method, for which the trajectory of an object is used,
whereby the trajectory of an object that is displayed
separately from a video image is used to efficiently
specify and display a video image scene desired by a
25 user, and also to provide an apparatus therefor.

Summary of the Invention

The present invention relates to a method for using the
30 trajectory of an object to access video contents to, for
example, specify and display a specific video image
scene. Such a video contents access method comprises the

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steps of: extracting objects from video contents; displaying the movements of the objects as trajectories on a specific projection screen; specifying locations along the trajectories; and accessing a desired scene

5   contained in the video contents.

Furthermore, according to the present invention, a video contents access apparatus comprises: display means for displaying, as trajectories on a specific projection

10   screen, the movements of objects extracted from video contents; and instruction means for specifying locations along the trajectories, whereby the above described video contents access method is performed.

15   According to the present invention, the objects, such as the states of players, are specified by using trajectories displayed on a projection screen, without directly providing a video for a user. Therefore, the process performed by a computer is simplified, and it is

20   anticipated that the status of a game will be reported to a user, even if the trajectories of the objects are displayed at high speed. In addition, the user can use a trajectory to determine which video frame is to be accessed, and only when the user selected a point on the

25   trajectory can the current frame jump to a corresponding frame and can a video be replayed. Furthermore, since the information carried by a trajectory interacts with an actual object in the contents, such as an individual player or a ball, to the user it will seem as though he

30   or she is controlling it directly. As a result, the desired video image scene can be efficiently specified and displayed.

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As the preferred embodiment of the present invention, the
trajectories of the objects are those that are displayed,
in order with time for video contents, in a time interval

5   lying between a currently displayed video frame and a
preceding video frame that was displayed a predetermined
time period earlier. Furthermore, a user can control the
speed at which the trajectories of the objects are
displayed. A scale (play advantage) for representing an

10   important scene is displayed on a projection screen by
using the trajectories (Traj) of the objects, which are
calculated using the following equation: Traj = (object
ID, start time, end time, line graph representation).
The video data are digital video data, or analog video

15   data that can manage time code. Furthermore, a window
for displaying images of said video contents and a window
for displaying said trajectories of said objects are
displayed on the same projection screen. To specify said
locations on said trajectories, points on the

20   trajectories are designated by using a pointing device.
In this embodiment, a plurality of video objects are
used, and with this arrangement, the present invention
can be efficiently carried out.

25   Brief Description of the Drawings

Preferred embodiments of the present invention will now
be described, by way of example only, with reference to
the accompanying drawings in which:

30   Fig. 1 is a flowchart for explaining the concept of a
method, according to the present invention, whereby the

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trajectory of an object is used for accessing video contents.

Fig. 2 is a photo diagram in which, for a soccer game that is used as an example, a window that is used for displaying images of video contents and a window that is used for displaying the trajectory of an object are shown on the same projection screen.

Fig. 3 is a flowchart for explaining one embodiment of the present invention wherein a window for displaying images of video contents and a window for displaying the trajectory of an object are shown on the same projection screen.

Fig. 4 is a photo diagram showing an example normal display screen for the flowchart in Fig. 3.

Fig. 5 is a photo diagram showing an example fast forward confirmation screen for the example in Fig. 3.

Fig. 6 is a diagram showing the arrangement of an apparatus for carrying out the video contents accessing method of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

Fig. 1 is a flowchart for explaining the concept, according to the present invention, of a method for accessing video contents by using the trajectories of objects. In Fig. 1, first, an object is extracted from

video contents using a conventional area division method
(step S1). Then, the movement of the object is displayed
as a trajectory on a specific projection screen (S2).
The time interval at which the movement of the object is
5   obtained as the trajectory is not especially specified.
However, if the trajectory is obtained for all the time
intervals, depending on the size of the projection
screen, the number of objects and the movement speeds,
the trajectory may become too complicated, and specifying
10   a frame during the following process will not be
possible. Therefore, it is preferable that the selected
time interval be between a currently displayed frame and
a preceding frame that was displayed several seconds to
several minutes earlier. In this manner, the video
15   contents can be scanned. Following this, a location on
the trajectory is specified by using a pointing device
(step S3). And finally, a desired scene in the video
contents is accessed. That is, the current frame jumps
to the video frame of the desired scene, which is then
20   displayed as a static scene, or replay is started
beginning with the selected scene (step S4).

An explanation will now be given for a case where the
present invention is applied for a sports video, such as
25   one for a soccer match, as an example of the method used
for accessing video contents by using the trajectory of
an object. In a sports video, such as one for a soccer
match, the position occupied by a player on a field, the
trajectory of the player's movement and the trajectory of
30   a soccer ball are very meaningful information. These
data can be manually entered, or can be obtained by
having a computer extract the objects represented by the

player and the ball, and shift information for a camera
that picks up the objects can be acquired by recovering a
camera parameter. These data for a specific scene can be
represented by using images as a set of trajectories on
5   the field, and what is depicted in the video can be
observed.

Fig. 2 is a diagram showing the existing state wherein
the trajectories of the movements of a plurality of
10   objects, i.e., players, during a predetermined time
period are displayed on a projection screen in an
overhead view of a soccer field. In Fig. 2, in a soccer
scene covering a 20 second period, the movements of the
main players are indicated by thin black lines, and the
15   movement of a ball is indicated by a thick red line. To
obtain this display, the objects are extracted from a
scene shot during an actual soccer match, the camera
movement parameter is automatically extracted, and the
movements of the individual objects are replayed on a
20   projection screen representing the soccer field. The
ball is passed several times in this scene, and the
passes are apparently identified on the screen.

The above representation is meaningful for video
25   contents, such as sports or surveillance, for which space
can be posited as a background, such as the soccer field
in Fig. 2, and wherein the position and movement of each
object on the background and a positional relationship
between them are closely related to the contents. In
30   accordance with a coordinate string and the time interval
used in the contents, the information concerning the

trajectories (Traj) are internally represented as
follows:

Traj = (object ID, start time, end time, line
representation), wherein the line representation denotes

5   the coordinate string of an object in an interval
extending from the start time to the end time. This
string can be a time series of coordinate values, or can
be represented by approximate lines. When approximate
line representation is used, the time at which the

10   coordinate value and the trajectory pass through a
specific point must be described as a pair, such as
(x,y,t), for individual nodes at the approximate lines.
As a result, if one point on the trajectory in the field
is designated, a point of intersection with the closest

15   line is calculated, and the time between two adjacent
nodes is interpolated to determine a corresponding time.
When the location is moved along the trajectory by using
a pointing device, such as a mouse, a preceding or
succeeding video scene can be accessed along the

20   corresponding time. Of course, the names of actual
players can be provided for the object IDs, and the
player's names can be superimposed on the individual
trajectories.

25   An explanation will now be given for an example where the
above data are used to scan the contents (e.g., a soccer
match) for a specific period of time. Since all the
trajectories are represented for an actual game of 90
minutes, they are written on the field many times.

30   Therefore, the movements of the objects are represented
by drawing the trajectories only for a specific time
period (e.g., one minute). A mechanism, in the form of a

slider, for adjusting the display speed for the trajectory is provided for a user.

Further, in this invention, a specific scale (play advantage) that represents an important scene can be displayed at the same time, separately from the soccer field, on the projection screen in Fig. 2 on which the trajectories of the objects are displayed. For a soccer game, for example, the play advantage for a team is represented as:

play advantage = 1.0 - (r/squrt (W*W + H*H)), wherein r denotes a distance representing how closely a player handling a ball has approached the goal of the opposing team; W denotes the length of a field along a touch line; and 2H denotes the length along a goal line. If the play advantage is expressed as a graph, in accordance with the time required for the playback of the trajectory, the user can use the play advantage as a guide for adjusting the speed for the playback of the trajectory.

Specifically, while a user monitors the playback of the trajectory and the play advantage, he or she can adjust the display speed and halt the playback at an appropriate and interesting scene. The user can move and click the pointing device to specify an interesting trajectory on the field at the time at which the video is halted, so that the actual video contents can be accessed. When, for example, the video is accessed in consonance with the movement of the ball, a scene wherein specific passes are made can be accessed. Further, if the user wants to view the video in consonance with the movement of a specific player, the user need only point at the trajectory for

that player. Furthermore, if, as on a soccer field,
areas are defined (goal areas or penalty areas), or when
the user wants to view the movement of a specific player
in the penalty area, only the intersection of the

5   trajectory and the penalty area need be designated and
the pertinent frame can be accessed and replayed.

For video contents, such as those obtained for sports
relay broadcasting using a plurality of cameras (when a

10   plurality of cameras is used to film a game), assuming
that the timings used for the cameras are almost fully
synchronized, the spatial representation essentially
indicates the same thing. Therefore, with trajectories
used as media, it is easy to view the states of the

15   players from another angle at a specific time, and the
surrounding circumstances when a specific play is
performed.

An explanation will now be given for an example wherein,

20   by using the video contents accessing method of the
present invention, a window for displaying images of
video contents and a window for displaying the
trajectories of objects are displayed on the same
production screen. Fig. 3 is a flowchart for this

25   example. In Fig. 3, first, in the normal replay process
(step S11), normal video replay is performed in a video
replay window, while in an object replay window, normal
replay is performed for an overhead view of an object for
which the trajectory, for a specific time period, remains

30   that which corresponds to the replayed video portion.
Then, on a confirmation screen for fast forward viewing
(step S12), in the video replay window the video is fast

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forwarded (frame skipping and displaying), while the
overhead view object, for which the above trajectory
remains the same, is displayed in the object replay
window and, at the same time, the above play advantage is
5   also displayed. Then, when a point in the displayed
trajectory interval is pointed at (or the fast forward is
halted), the scene moves to the head of a corresponding
frame, so that normal replay is resumed (step S13). The
processing for this example is performed by repeating
10   steps S11, S12 and S13. The individual steps will now be
described.

Fig. 4 is a diagram showing an example display screen in
the normal replay process (step S11). In Fig. 4, window
15   1 is used to display images of video contents, and window
2 is used to display the trajectory of an object. In
window 1, video data are replayed. Digital video data,
such as MPEG-1/2, or analog video data, which can manage
time code, can be used as the video data. In window 2,
20   the object in the overhead view is replayed. To replay an
object, meta-data (the location of an object, the team of
the object, an object ID, etc.) for an object extracted
from video data, and the filming condition (the location
of a camera and a moving parameter) are displayed as
25   needed. In the example in Fig. 4, the video data are
replayed and displayed at normal speed in accordance with
a change in the positional information for an object (a
player or a ball). Assuming that the meta-data for the
object have previously been extracted, based on the
30   location of a camera, which represents the filming
condition, and the moving parameter for the camera, the

meta-data are converted to plot the location of the
object in the overhead view.

Fig. 5 is a diagram showing an example display for a
confirmation screen for fast forward (step S12). In the
example in Fig. 5, window 1 for displaying images of
video contents is not shown. In window 1, video is fast
forwarded (frame skipping and displaying). Since during
fast forward all the video frames are not replayed, a
time interval that is appropriate for the replay speed is
used for the replay of the frames. In window 2, for
displaying the trajectory of an object, the overhead view
of an object that continues to follow the trajectory for
a specific time period is displayed. That is, all the
objects that appear in the film are converted into those
in the overhead view, and are displayed as moving objects
on a pitch screen. When the film is fast forwarded,
noise may be generated or the movement of an object may
be missed; however, when the objects moving on the pitch
screen are used, the game as a whole can be observed.
Further, since the trajectory of an object is also
displayed at specific time intervals, the chances are
reduced that the movement of the object will be missed
during fast forwarding. In the example in Fig. 5, the
play advantage of a team is displayed along the time axis
in the lower part the window 2. That is, a numerical
value, which is a reference (play advantage) for the fast
forward speed, is displayed along the time axis, and the
user uses the value of the play advantage as a reference
when increasing or reducing the replay speed. As for the
play advantage, the possibility of a player scoring in a
soccer game is used as a reference, and the distance from

an approaching player who is handling a ball to the goal
of an opposing team is represented along the time axis.
Different colors are used to identify the teams.

Finally, the resumption of the normal replay (step S13)
is performed as follows. Since during fast forwarding a
user may pass a desired scene, the user can use a mouse
to click on a point along the trajectory to automatically
track a corresponding frame.

Fig. 6 is a diagram showing an example arrangement of an
apparatus for carrying out the video contents accessing
method of the present invention. In Fig. 6, the
apparatus comprises: a video device 11, for replaying
video contents; a computer 12, including a circuit for
extracting objects from video contents; a display device
13, for displaying the movements of the objects as
trajectories on a specific projection screen; and a
pointing device 14, for specifying a location on the
trajectory. With this arrangement, the pointing device
14 is used to click on a location along the trajectory on
the display device 13, so that a desired scene contained
in the video contents can be accessed.

The following functional arrangement of the above
described present invention is the most important
feature.
(1) A function, for using an interface that uses a
trajectory on a projection screen to represent the status
of a player, is provided for designating a point on the
trajectory using the pointing device and jumping from the
designated point to a corresponding video frame, or for

moving a pointer along the trajectory to replay a
corresponding video frame. This function is used for
efficient video accessing.

(2) The trajectories of objects, for scanning the video
5   contents, are displayed in order with time for the
contents, and the status of the contents is reported to
the user. A user does not experience an odd sensation
even when the speed at which the trajectory is displayed
is higher than the actual video rate, and throughout a
10   game can view the movements of players at a high speed.

(3) A method for controlling the display speed for
trajectories is provided for the user. Thus, the user
can fast forward unimportant portions, and replay in slow
motion the trajectory of important portions. At this
15   time, the scale (play advantage) that indicates an
important scene, e.g., a numerical value that represents
the possibility of a player scoring in a soccer game, is
displayed at the same time, so that the scale can act as
a guideline and help a user decide how to adjust the
20   speed, and when to halt the display and access the video
data.

As is described above in detail, the objects, such as the
states of players, are specified by using trajectories
25   displayed on a projection screen, without directly
providing a video for a user. Therefore, the process
performed by a computer is simplified, and it is
anticipated that the status of a game will be reported to
a user, even if the trajectories of the objects are
30   displayed at high speed. In addition, the user can use a
trajectory to determine which video frame is to be
accessed, and only when the user has selected a point on

the trajectory can the current frame jump to a
corresponding frame and can a video be replayed.
Furthermore, since the information carried by a
trajectory interacts with an actual object in the

5   contents, such as an individual player or a ball, to the
user it will seem as though he or she is controlling it
directly. As a result, the desired video image scene can
be efficiently specified and displayed.

10   While the invention has been particularly shown and
described with respect to preferred embodiments thereof,
it will be understood by those skilled in the art that
the foregoing and other changes in form and details may
be made therein without departing form the spirit and

15   scope of the invention.